



Corneal Confocal Microscopy for Disease Management of Peripheral Neuropathies

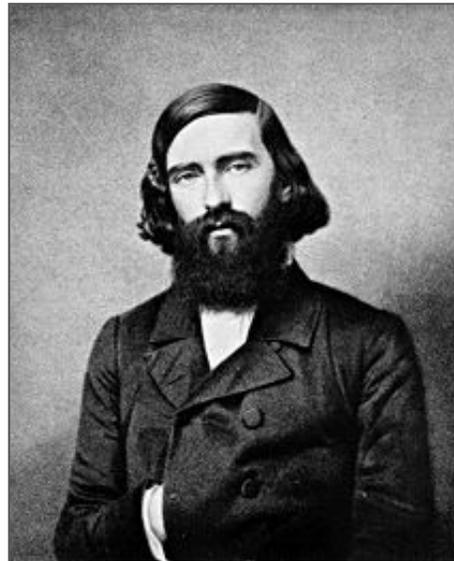
Rudolf F. Guthoff
University of Rostock
Department of Ophthalmology
Germany

The longer you can look back,
the farther you can look forward.

Winston Churchill, 1944
at the Royal College of Physicians



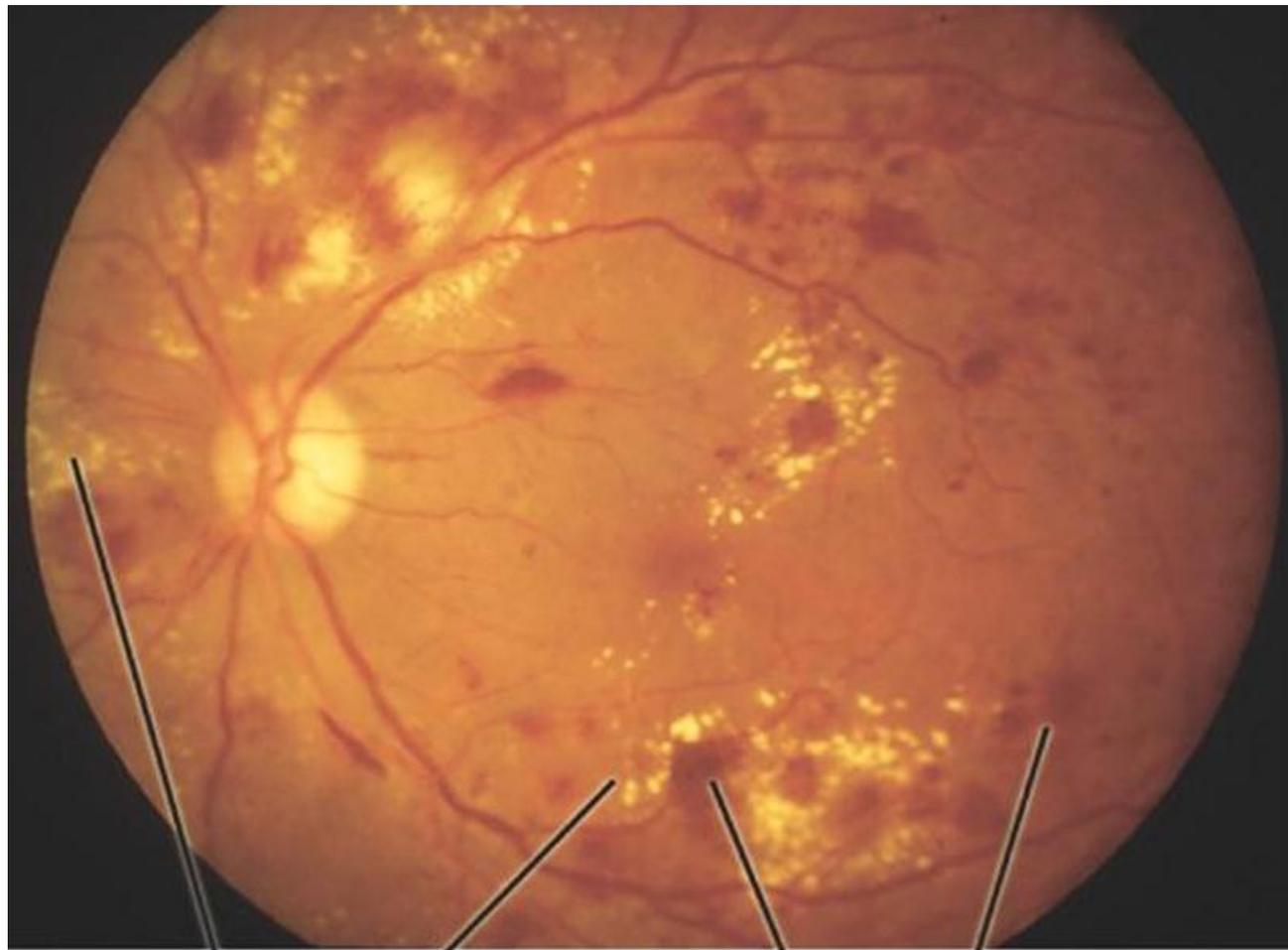
v. Helmholtz



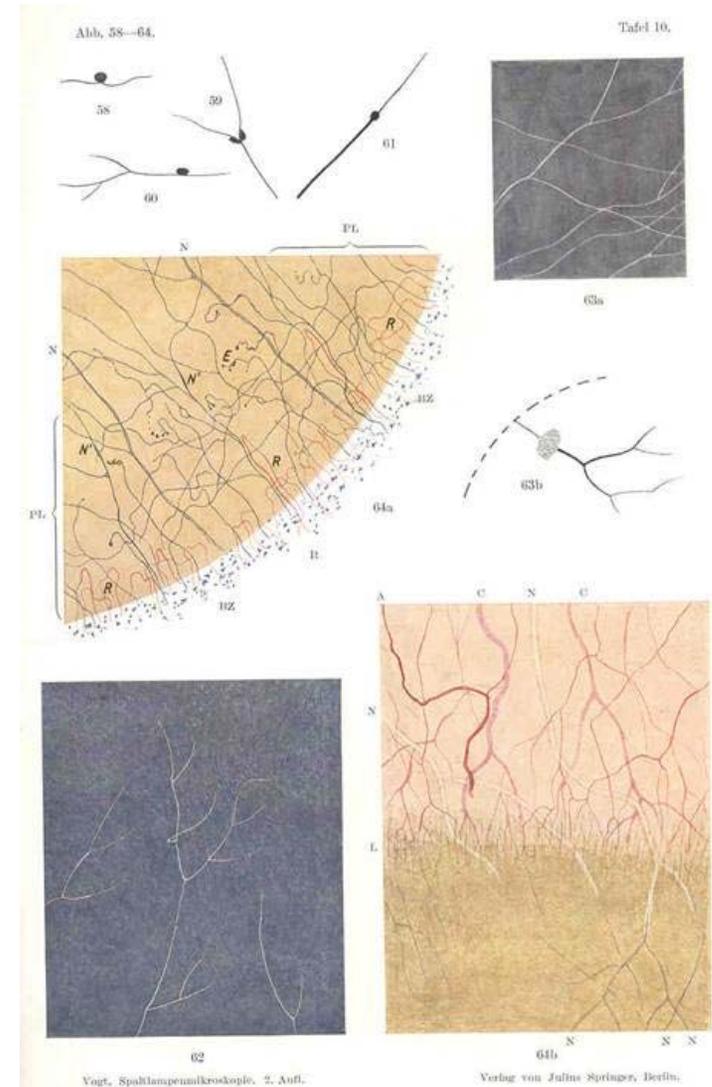
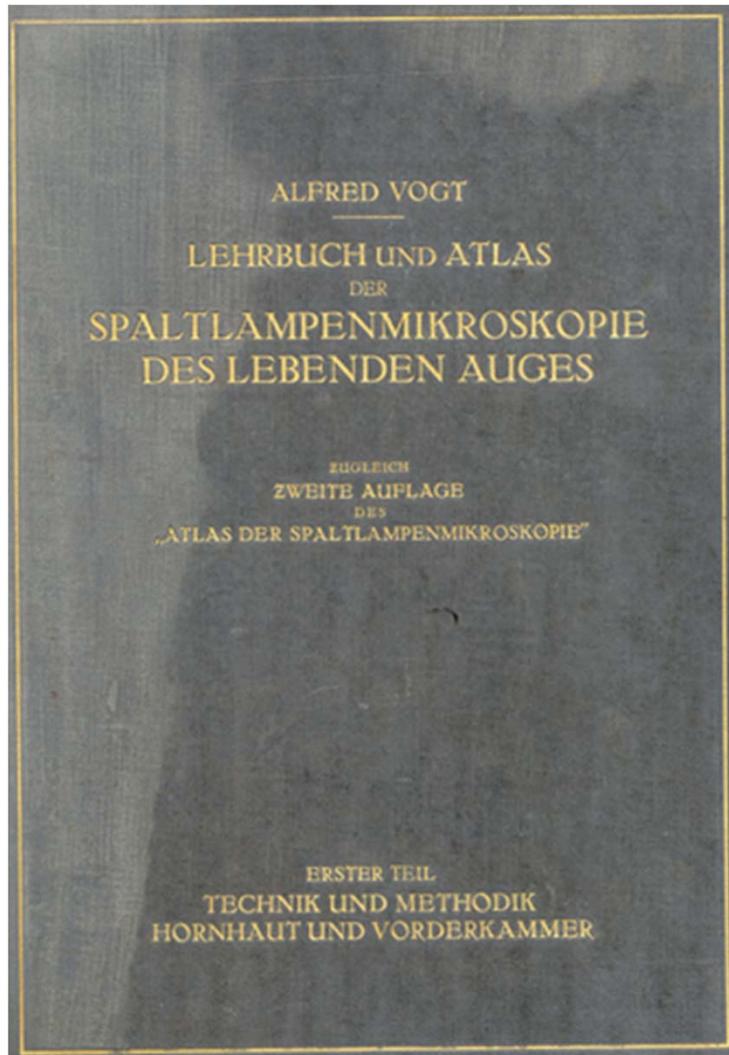
v. Graefe



- Hermann von Helmholtz (1851): inventor of ophthalmoscopy
Jäger
- Albrecht von Graefe (1855) and Eduard Jäger von Jaxtthal (1856):
early description of diabetic retinopathy



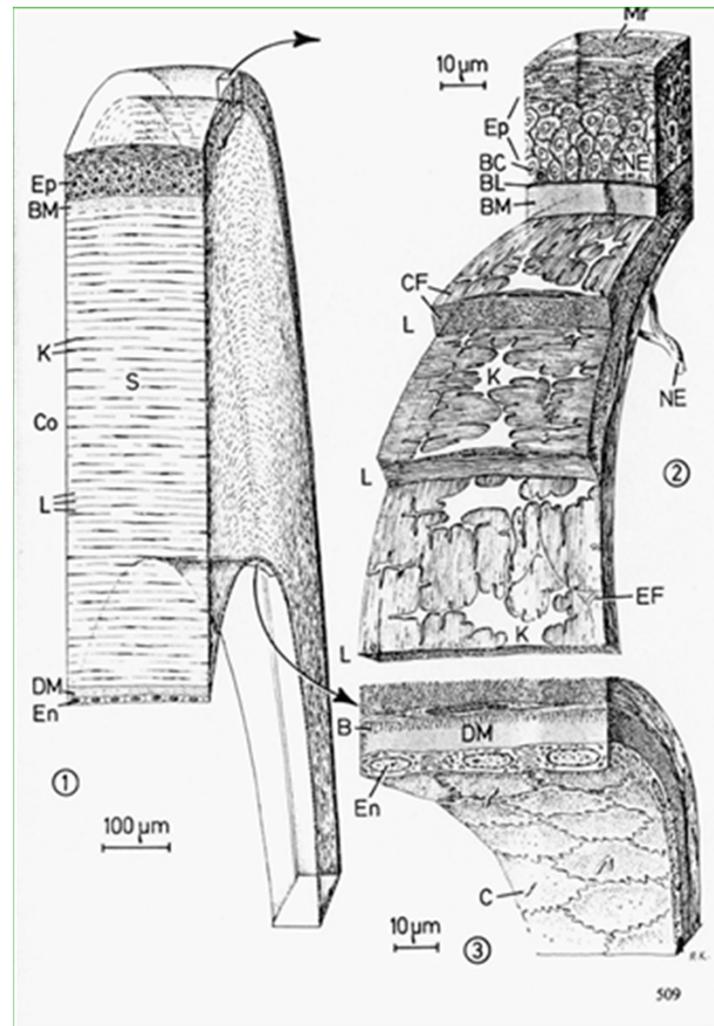
lipid exudate intraretinal hemorrhages



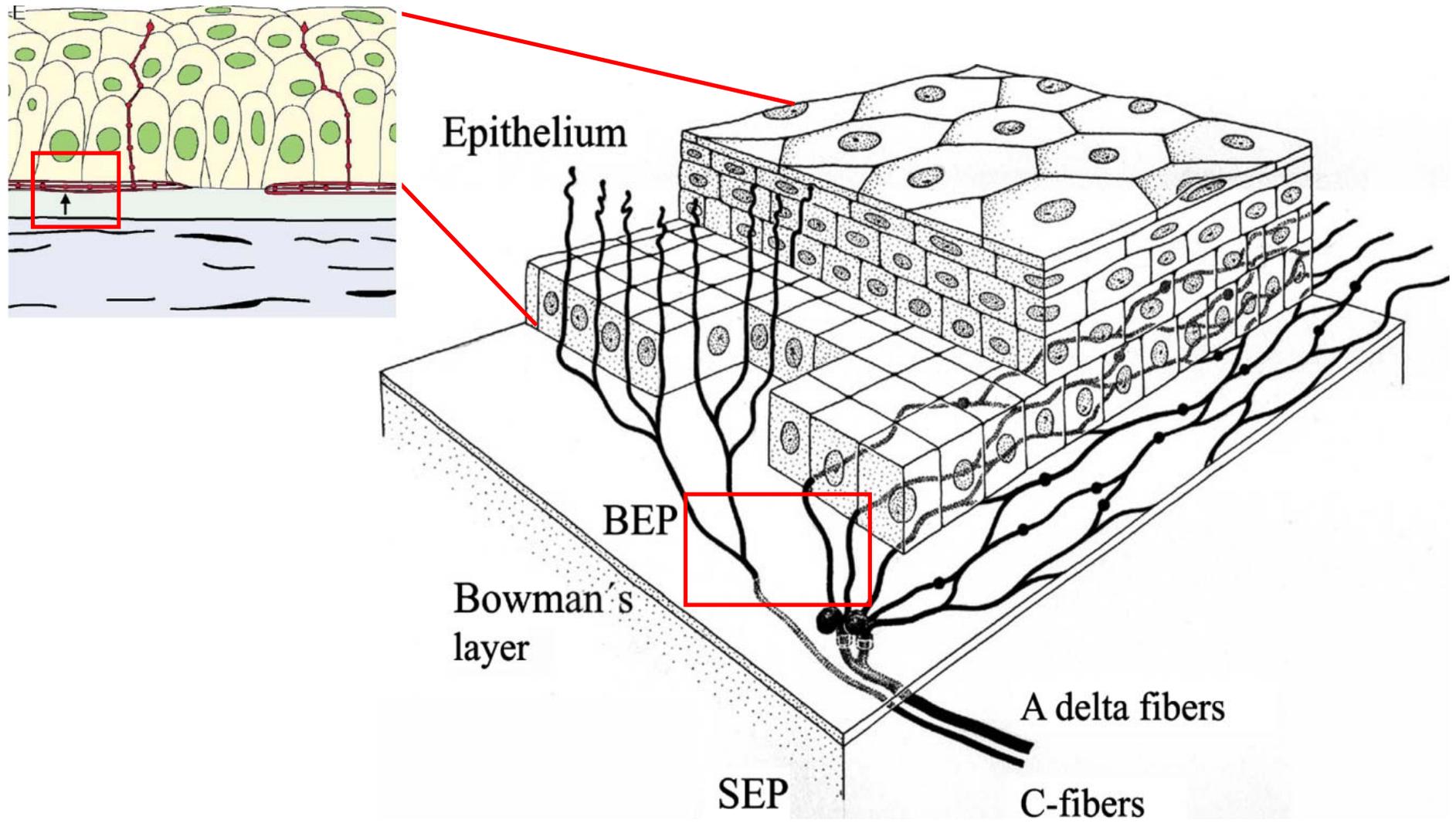
Human Cornea, Marfurt 2010



Human Microscopic Anatomy: Krstic 1991



Corneal Innervation, Guthoff 2005

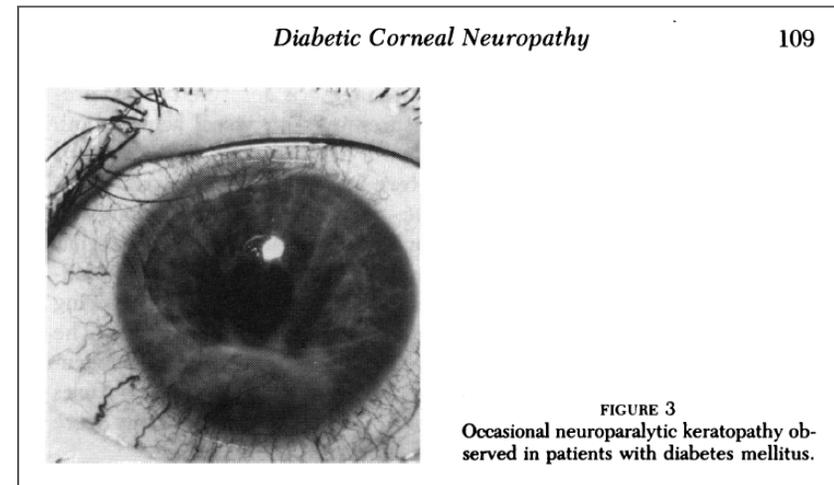


Pioneers of confocal in-vivo microscopy

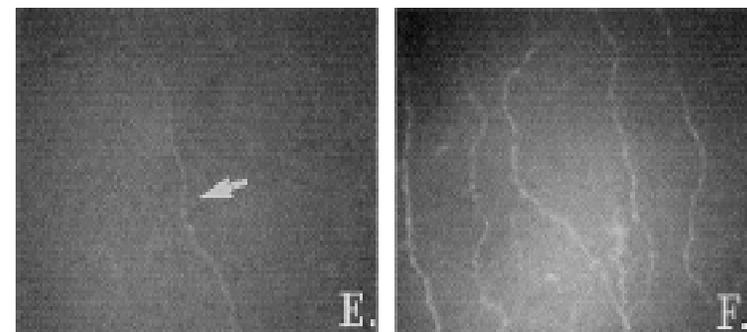
David Maurice, 1974

C. J. Köster, 1980

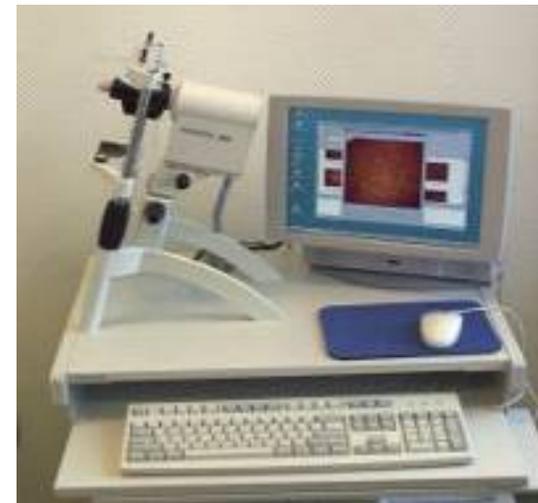
Schultz, R.O., Peters, M.A., Sobocinski, K., Nassif, K., Schultz, K.J. *Diabetic Corneal Neuropathy.* Tr Am Ophth Soc, Vol. LXXXI, **1983**:107-24



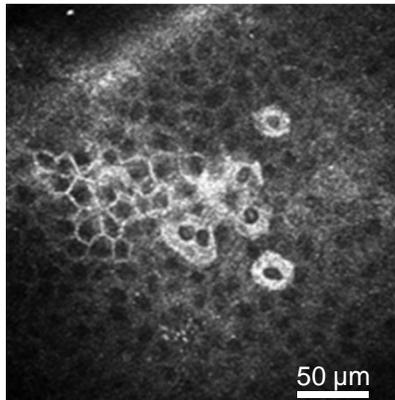
Rosenberg, M.E., Tervo, T.M.T., Immonen, I.J., Müller, L.J., Grönhagen-Riska, C., Vesaluoma, M.H. *Corneal Structure and Sensitivity in Type 1 Diabetes Mellitus.* Invest Ophthalmol & Visual Science, Vol. 41 (10), **2000**: 2915-21



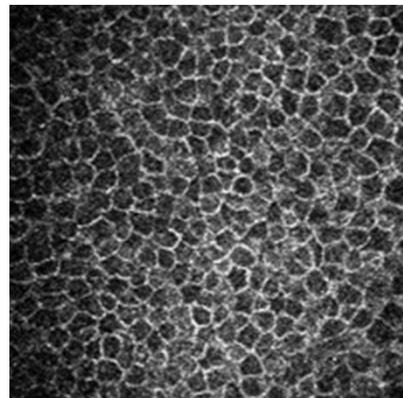
In vivo Confocal Microscopy



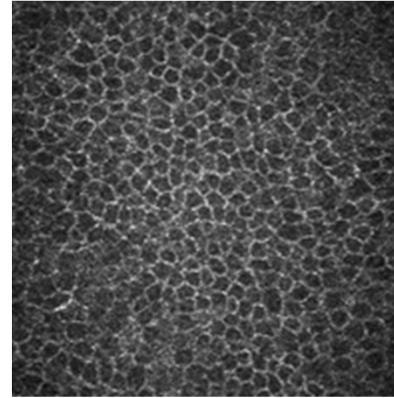
Confocal Microscopy of the Cornea



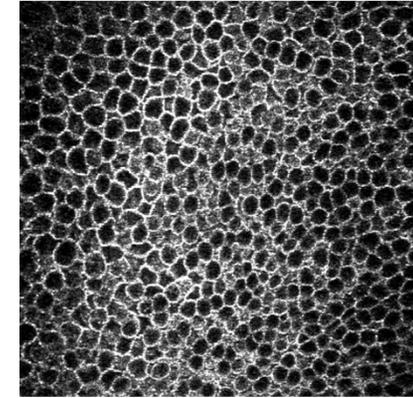
0 μm



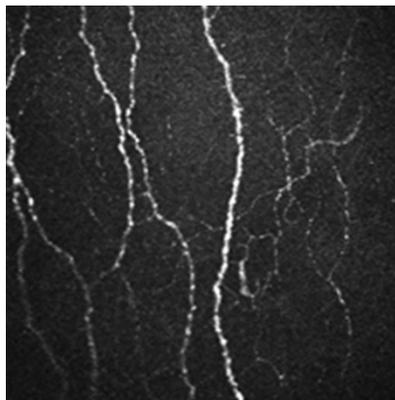
10 μm



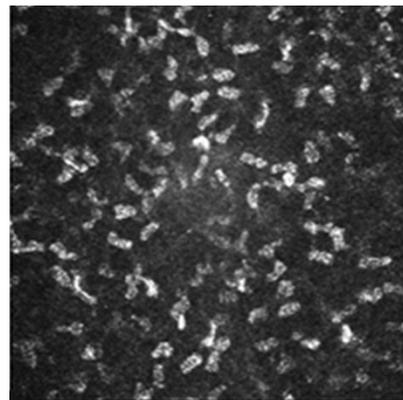
30 μm



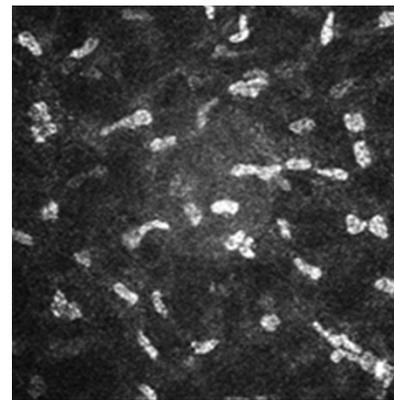
40 μm



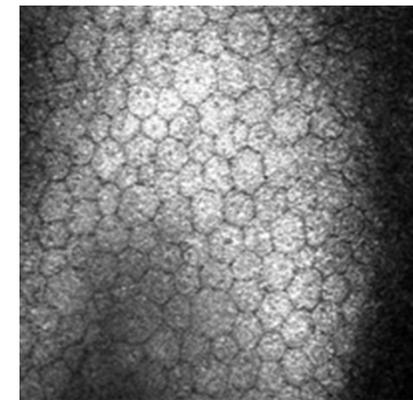
62 μm



100 μm

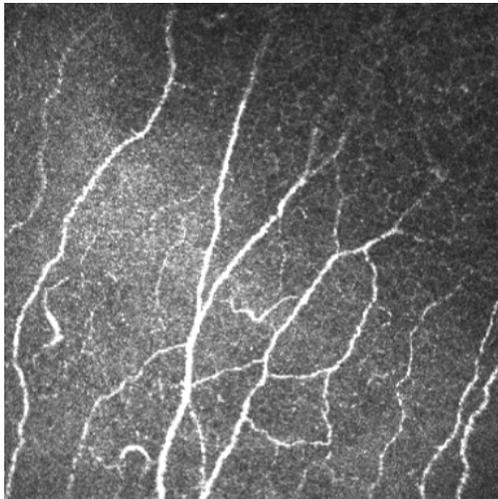


300 μm



572 μm

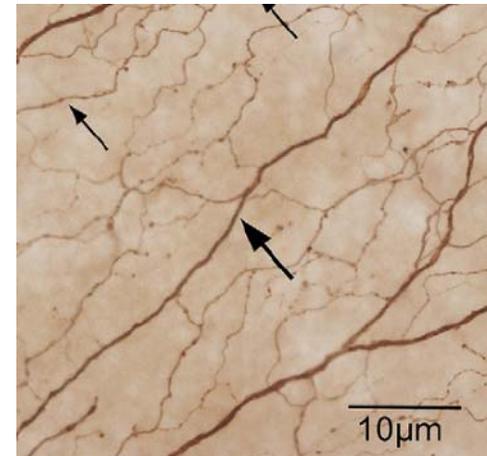
In vivo



Reichard et al., 2010

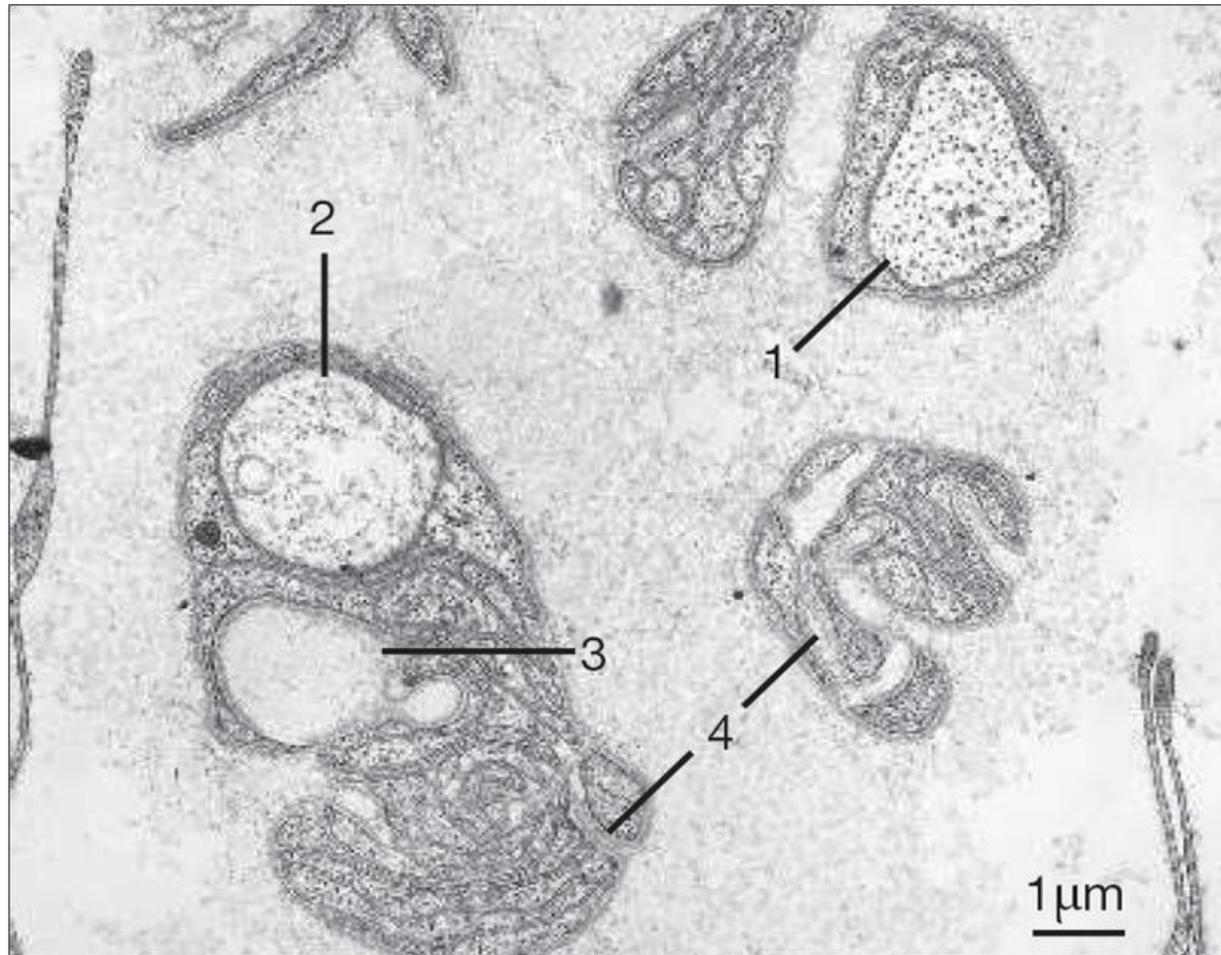


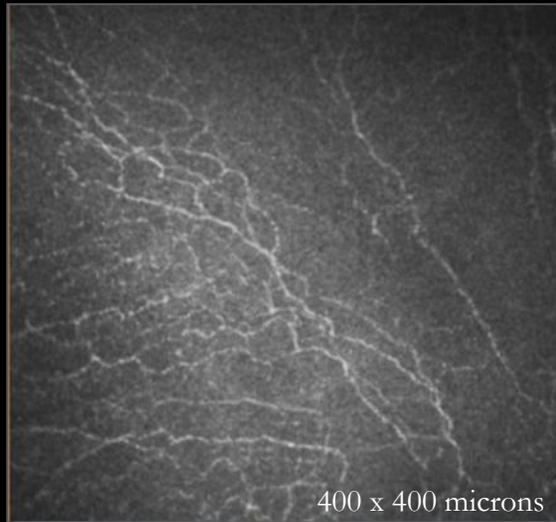
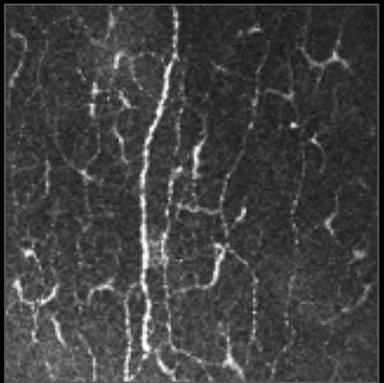
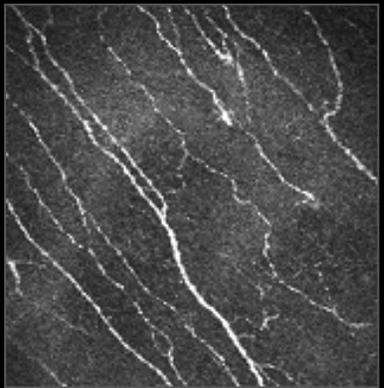
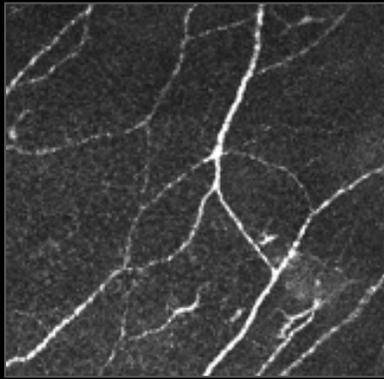
Ex vivo



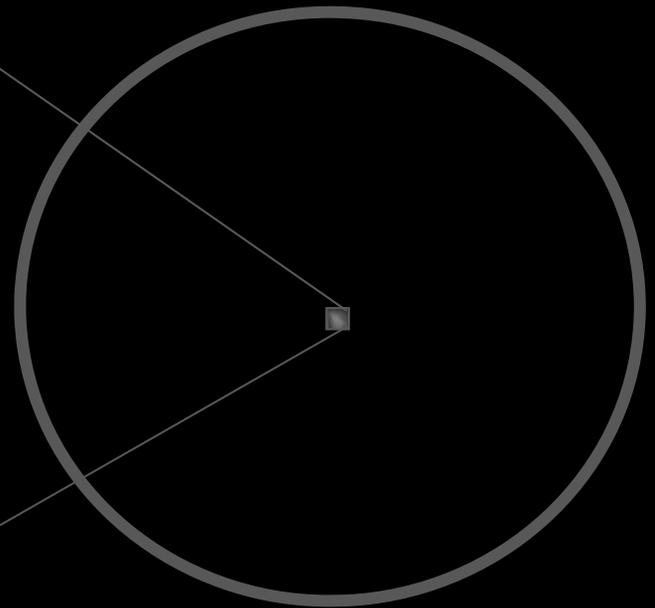
Marfurt et al., 2010

Morphology of DN - Nervus suralis, *Said 2007*

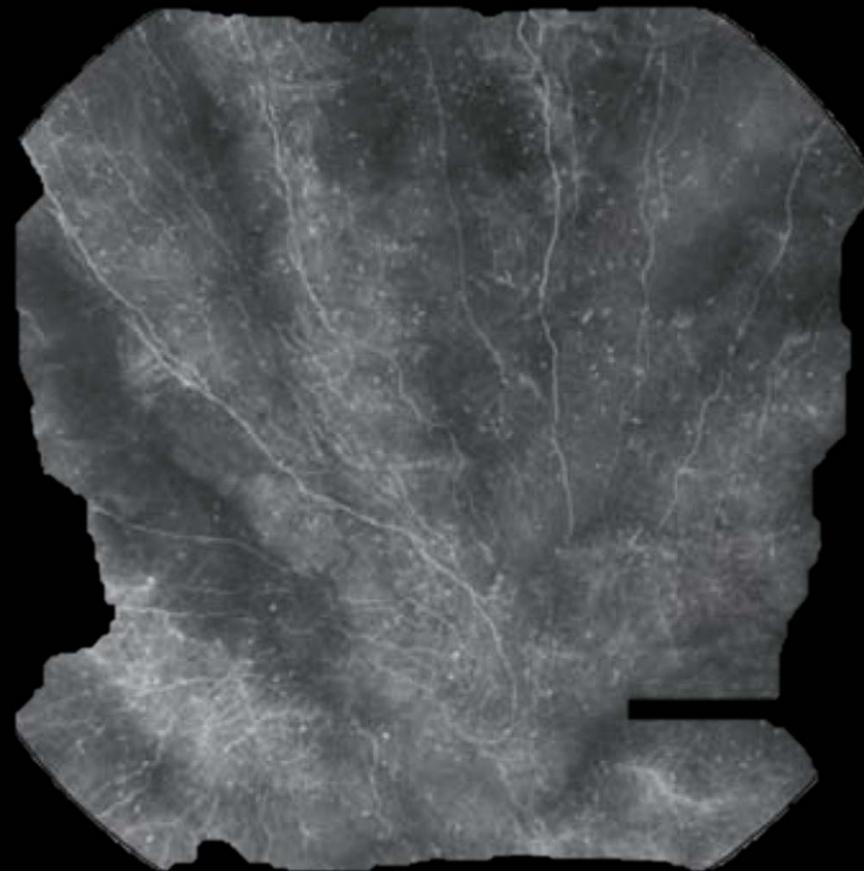




400 x 400 microns

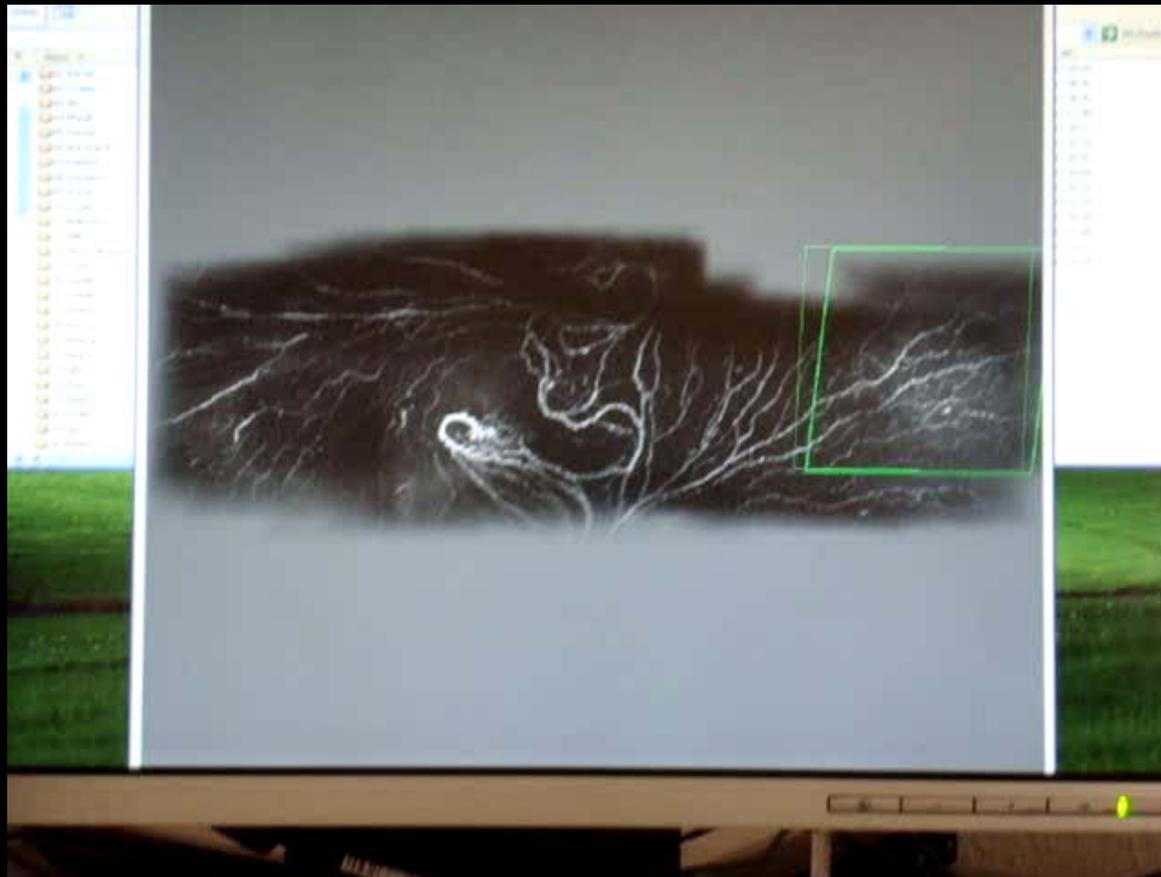


manual 2D composite

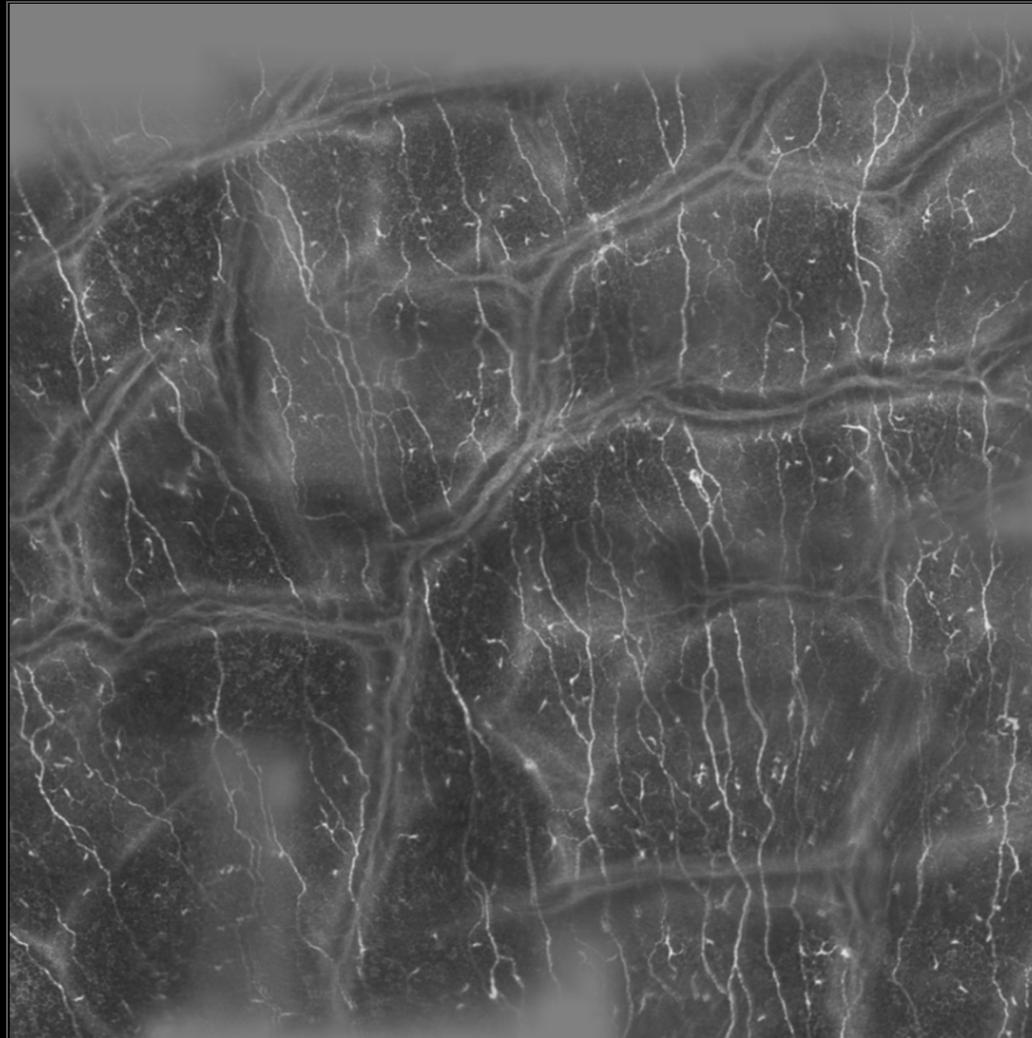


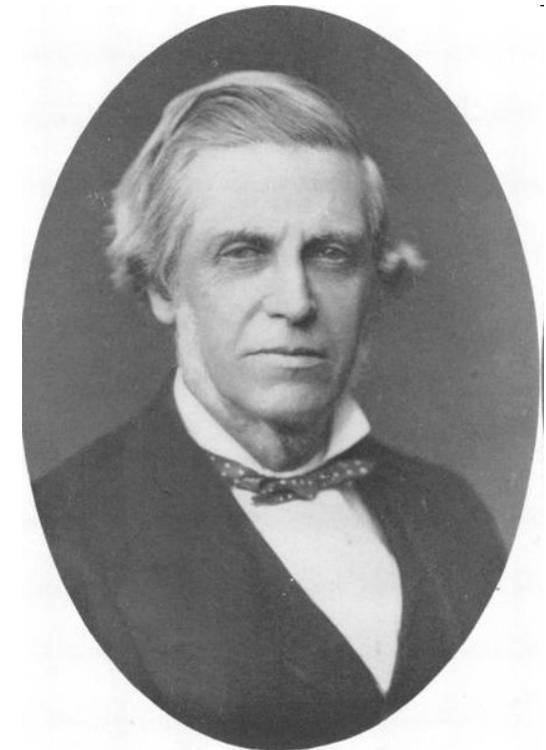
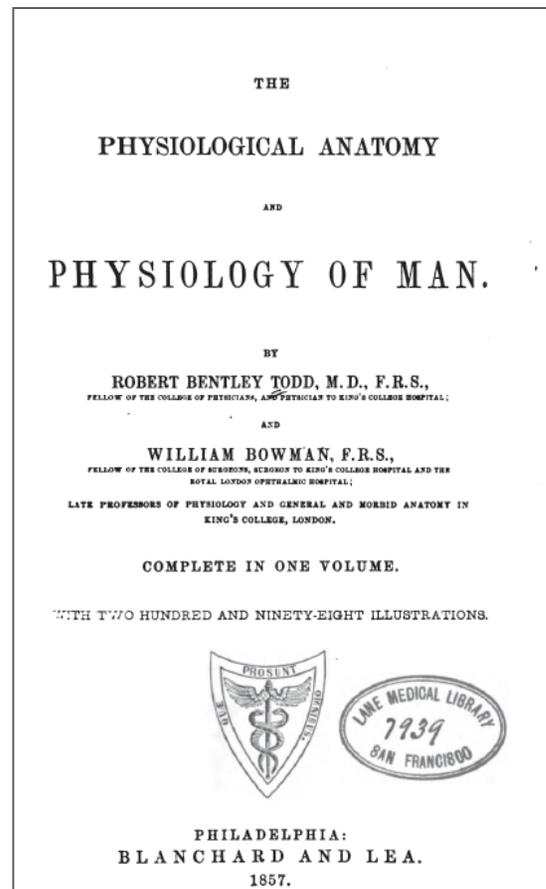
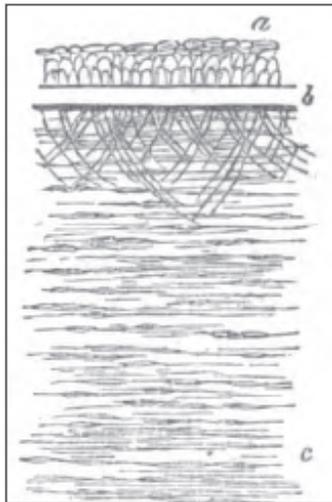
Efron 2011

On line 2D composite



On line 2D composite

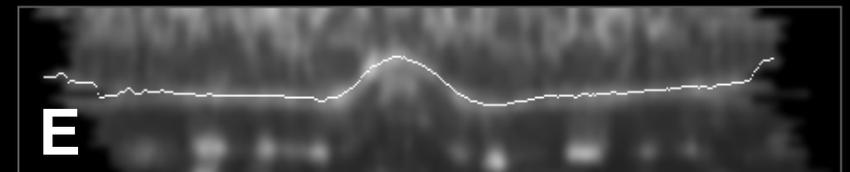
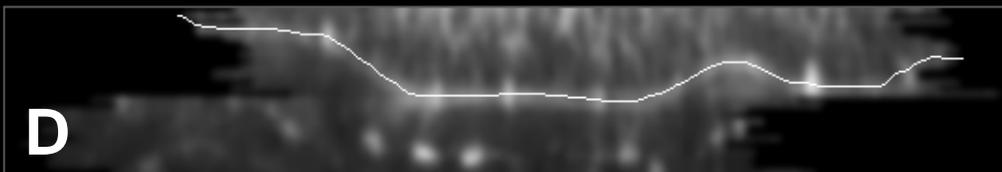
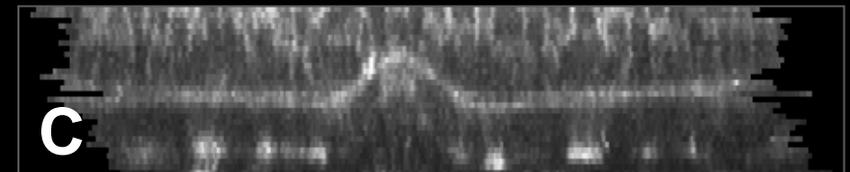
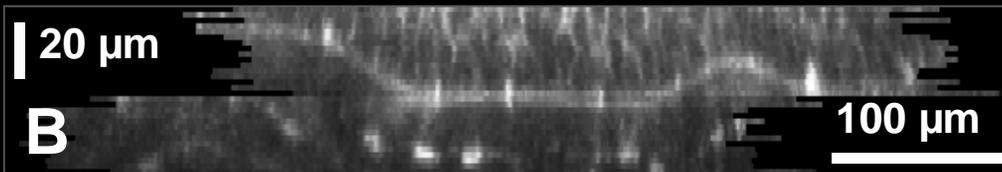
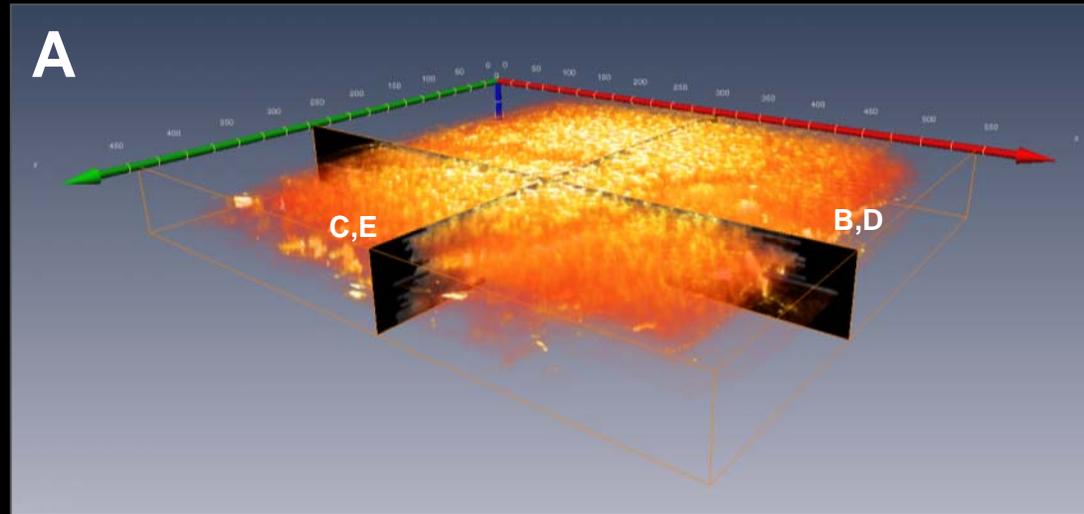




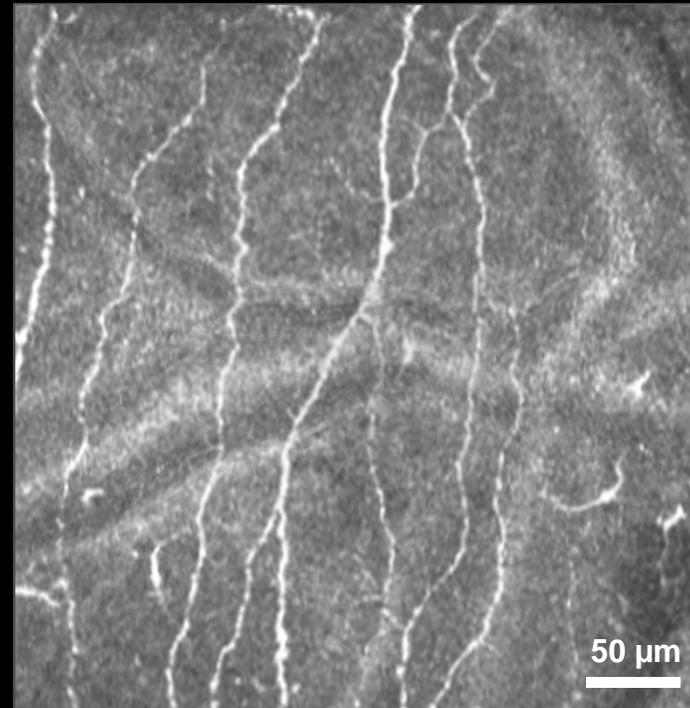
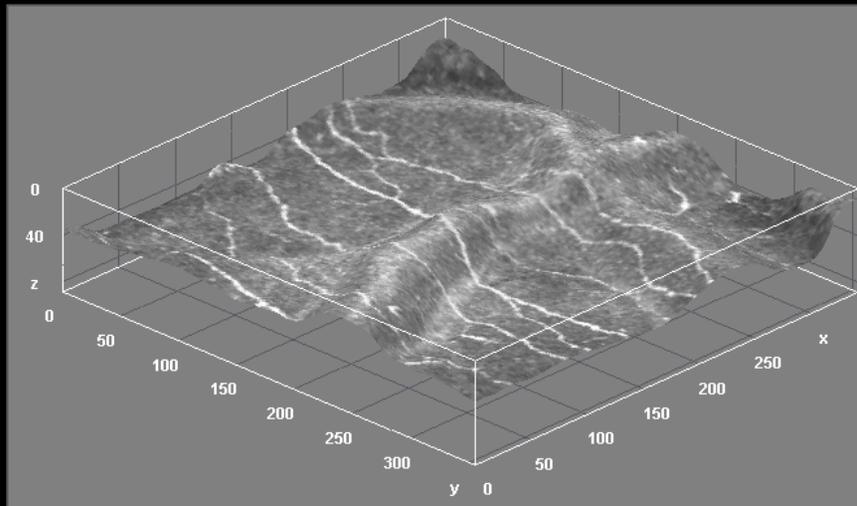
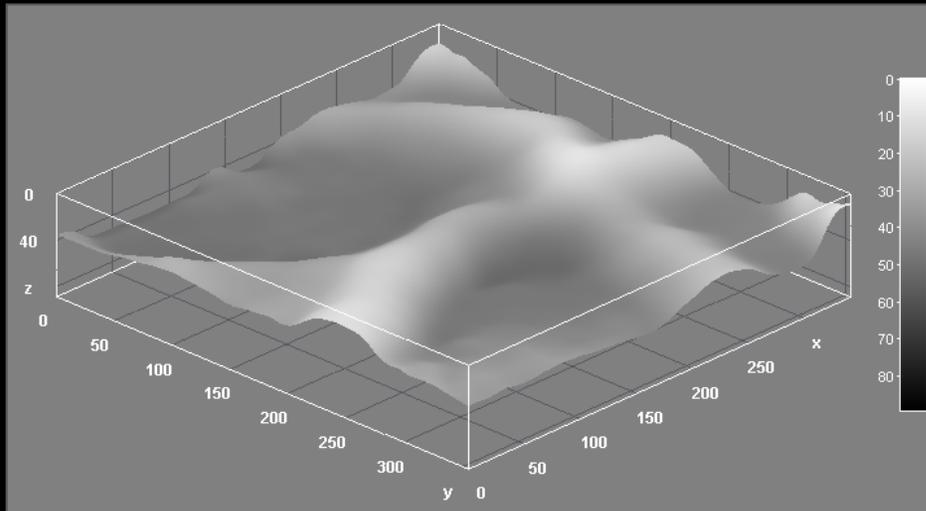
Sir William Bowman

1816 - 1892

SNP reconstruction, *Allgeier 2011*



SNP reconstruction, *Allgeier 2011*



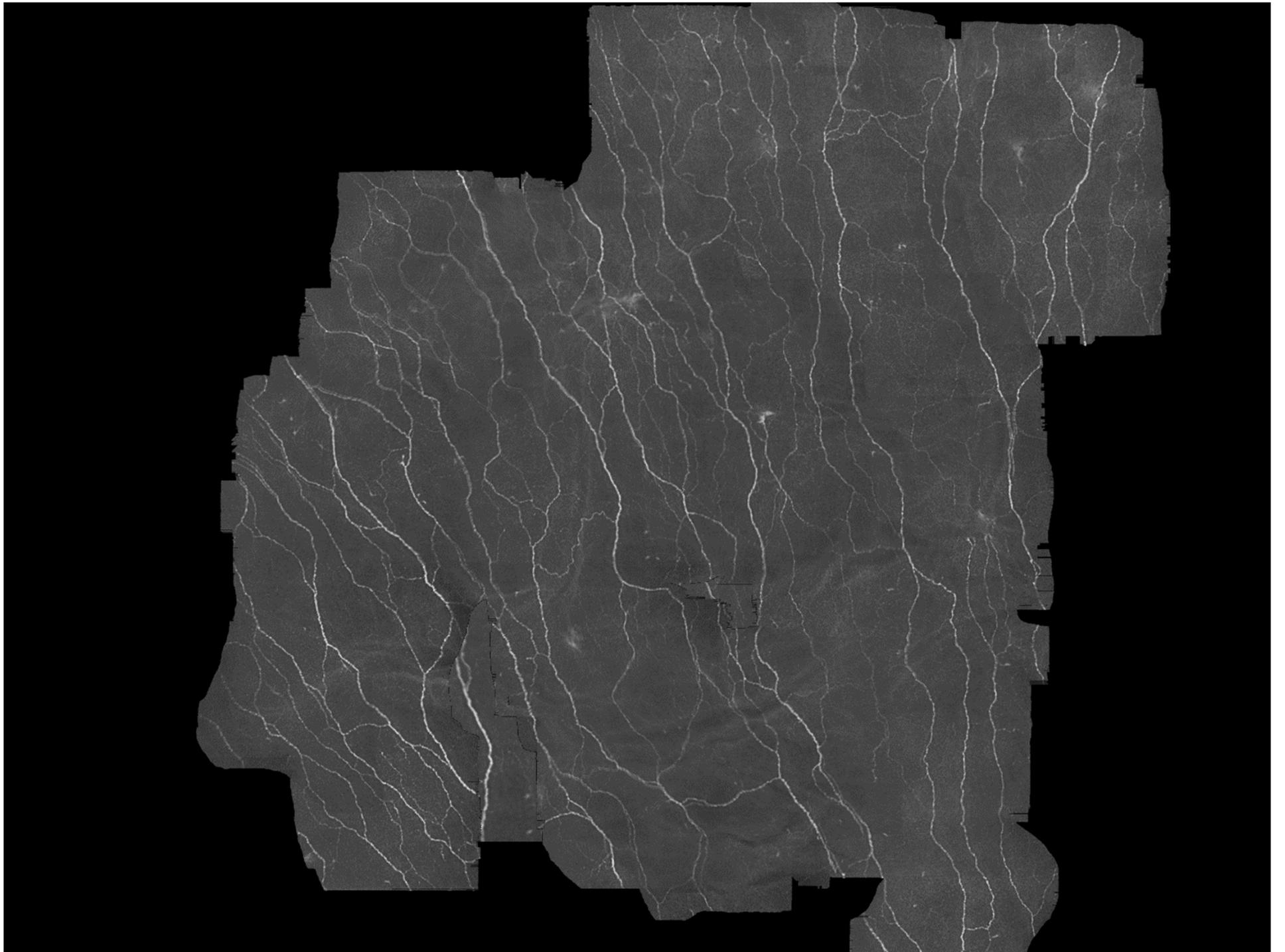
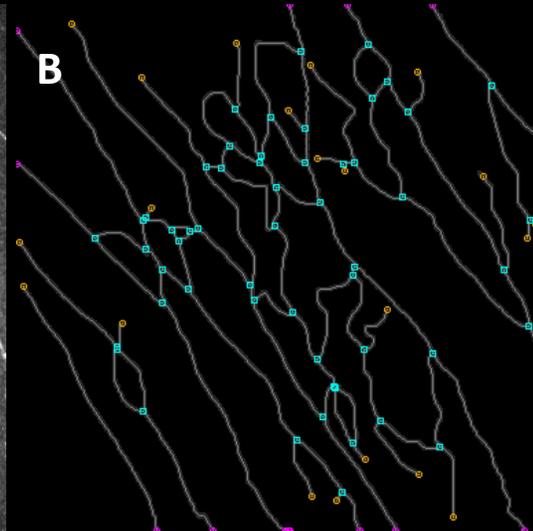
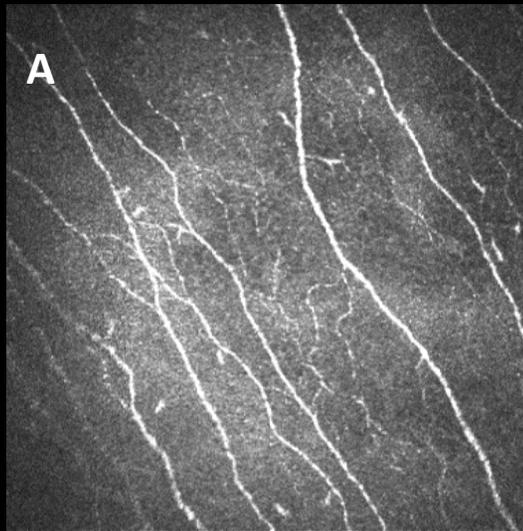
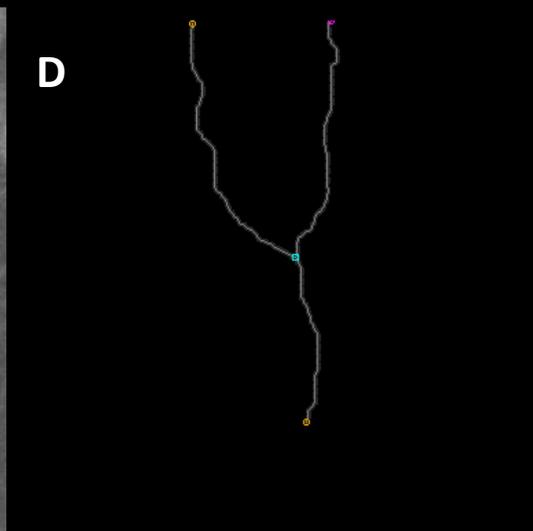
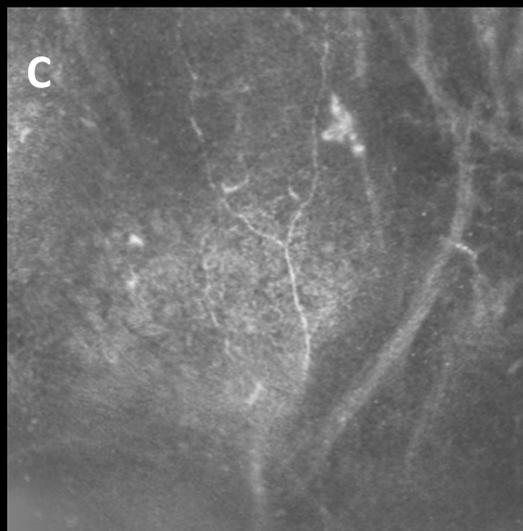


Image analysis – quantification, *Zhivov 2013*



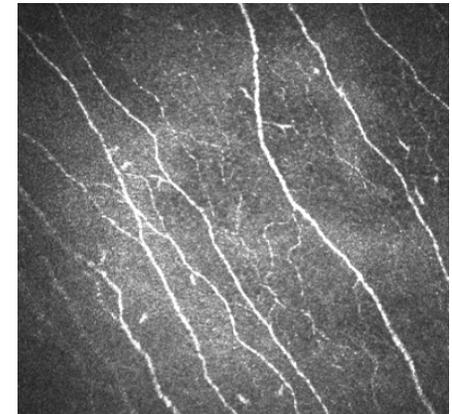
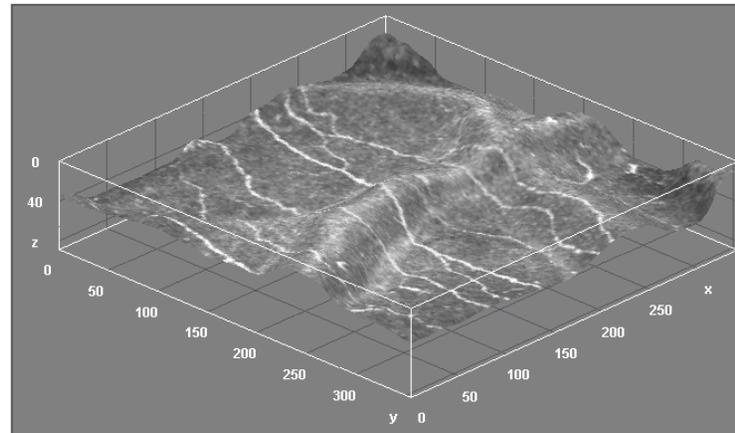
Healthy volunteer



Subjct with DN

Conclusions

1. Corneal subbasal nerve plexus can be registered and visualized by in-vivo confocal microscopy



2. Computer assisted quantification of subbasal nerve fibres in regard to

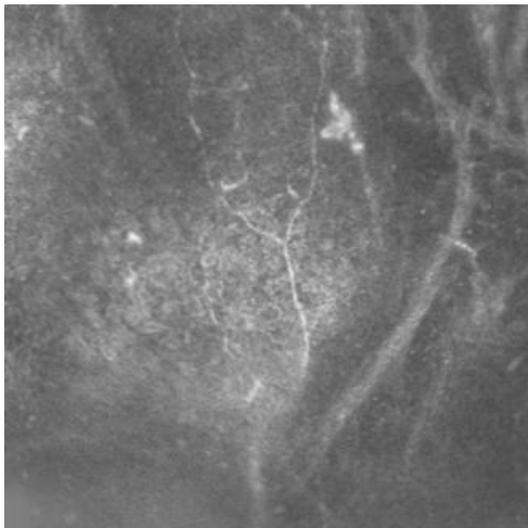
- a) length,
- b) density,
- c) tortuosity

is highly desirable and most likely to be ready for use.

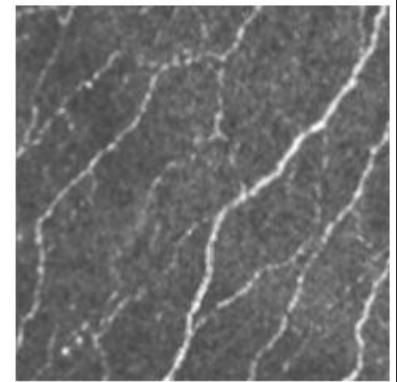
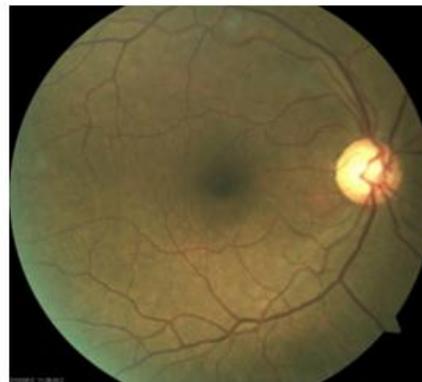


Conclusions

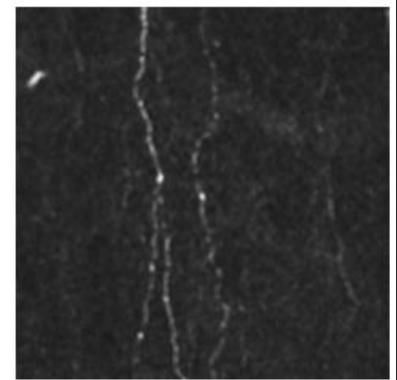
3. There is no close statistical correlation between diabetic neuropathy and diabetic retinopathy.



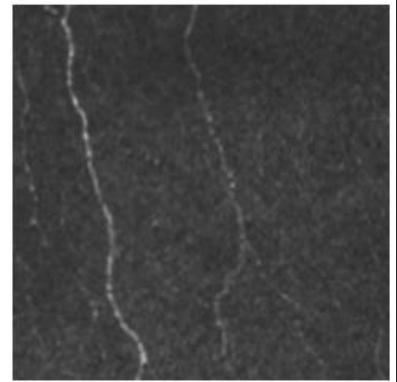
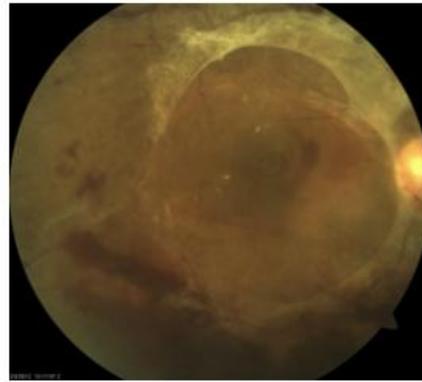
Wagner 0-1



Wagner 2-3



Wagner 4-5



It is beneficial to include corneal nerve fibre analysis in diagnosis and management of peripheral neuropathies.

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